CHAPTER 3

Motion in a Plane

Vectors

1. If the magnitude of sum of two vectors is equal to the magnitude of difference of the two vectors, the angle between these vectors is: *(2016 - I)*

a. 1° b. 90°

c. 45° d. 180°

2. A particle moves so that its position vector is given by $\vec{r} = \cos\omega t\hat{x} + \sin\omega t\hat{y}$ where ω is a constant Which of the following is true? *(2016 - I)*

a. Velocity and acceleration both are perpendicular to $\vec{r}$

b. Velocity and acceleration both are parallel to $\vec{r}$

c. Velocity is perpendicular to $\vec{r}$ and acceleration is directed towards the origin

d. Velocity is perpendicular to $\vec{r}$ and acceleration is directed away from the origin

3. If vectors $\vec{A} = \cos\omega t\hat{i} + \sin\omega t\hat{j}$ and $\vec{B} = \cos\frac{\omega t}{2}\hat{i} + \sin\frac{\omega t}{2}\hat{j}$ are functions of time, then the value of t at which they are orthogonal to each other are: *(2015 Re)*

a. t = 0 b. $t = \frac{\pi}{4\omega}$

c. $t = \frac{\pi}{2\omega}$ d. $t = \frac{\pi}{\omega}$

Motion in a Plane with Contant Acceleration

4. The '*x*' and '*y*' coordinates of the particle at any time are '*x*' = 5t – 2t² and '*y*' = 10t, respectively, where '*x*' and '*y*' are in metres and 't' in seconds. The acceleration of the particle at t = 2 s is: *(2017-Delhi)*

a. 5 m/s² b. –4 m/s²

c. –8 m/s² d. 0

5. The position vector of a particle $\vec{R}$ as a function of time is given by:

$\vec{R} = 4\sin(2\pi t)\hat{i} + 4\cos(2\pi t)\hat{j}$

Where R is in metres, t is in seconds and $\hat{i}$ and $\hat{j}$ denote unit vectors along x and y-direction, respectively. Which one of the following statements is wrong for the motion of particle? *(2015)*

a. Path of the particle is a circle of radius 4 metre

b. Acceleration vectors is along $-\vec{}$

c. Magnitude of acceleration vector is $\frac{v^2}{R}$ where v is the velocity of particle.

d. Magnitude of the velocity of particle is 8 metre/second

6. A particle is moving such that its position coordinates (x, y) are:

(2 m, 3 m) at time t = 0,

(6 m, 7 m) at time t = 2 s and

(13 m, 14 m) at time t = 5 s

Average velocity vector $(\vec{V}_{av})$ from t = 0 to t = 5 s is: *(2014)*

a. $\frac{1}{5}(13\hat{i} + 14\hat{j})$ b. $\frac{7}{3}(\hat{i} + \hat{j})$

c. $2(\hat{i} + \hat{j})$ d. $\frac{11}{5}(\hat{i} + \hat{j})$

Projectile Motion

7. A ball is projected with a velocity, 10 ms^{-1}, at an angle of 60° with the vertical direction. Its speed at the highest point of its trajectory will be: *(2022)*

a. 10 ms^{-1} b. Zero

c. $5\sqrt{3}\,ms^{-1}$ d. 5 ms^{-1}

8. A particle moving in a circle of radius R with a uniform speed takes a time T to complete one revolution.

If this particle were projected with the same speed at an angle 'θ' to the horizontal, the maximum height attained by it equals 4R. The angle of projection, θ, is then given by: *(2021)*

a. $\theta = \cos^{-1}\left(\frac{\pi^2 R}{gT^2}\right)^{1/2}$ b. $\theta = \sin^{-1}\left(\frac{\pi^2 R}{gT^2}\right)^{1/2}$

c. $\theta = \sin^{-1}\left(\frac{2gT^2}{\pi^2 R}\right)^{1/2}$ d. $\theta = \cos^{-1}\left(\frac{gT^2}{\pi^2 R}\right)^{1/2}$

9. A car starts from rest and accelerates at 5 m/s^2. At t = 4 s, a ball is dropped out of a window by a person sitting in the car. What is the velocity and acceleration of the ball at t = 6s ? *(2021)*

a. 20 m/s, 0

b. $20\sqrt{2}$ m / s, 0

c. $20\sqrt{2}$ m / s, 10 m / s^2

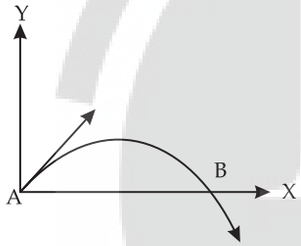
d. 20 m/s, 5 m/s^2

10. A projectile is fired from the surface of the earth with a velocity of 5 ms^{-1} and angle θ with the horizontal. Another projectile fired from another planet with a velocity of 3 ms^{-1} at the same angle follows a trajectory which is identical with the trajectory of the projectile fired from the earth. The value of the acceleration due to gravity on the planet is (in ms^{-2}) is: (given g = 9.8 ms^{-2}) *(2014)*

a. 3.5 b. 5.9

c. 16.3 d. 110.8

11. The velocity of a projectile at the initial point A $\left(2\hat{i}+3\hat{j}\right)$ m/s. Its velocity (in m/s) at point B is: *(2013)*



a. $2\hat{i}+3\hat{j}$

b. $-2\hat{i}-3\hat{j}$

c. $-2\hat{i}+3\hat{j}$

d. $2\hat{i}-3\hat{j}$

Relative velocity in 2- D

12. The speed of a swimmer in still water is 20 m/s. The speed of river water is 10 m/s and is flowing due east. If he is standing on the south bank and wishes to cross the river along the shortest path, the angle at which he should make his strokes w.r.t. north is given by: *(2019)*

a. 30° west b. 0°

c. 60° west d. 45° west

13. A ship A is moving Westwards with a speed of 10 km/h and a ship B 100 km South of A, is moving Northwards with a speed of 10 km/h. The time after which the distance between them becomes shortest, is: *(2015)*

a. 5 h b. $5\sqrt{2}$ h

c. $10\sqrt{2}$ h d. 0 h

Uniform circular motion

14. Two particles A and B are moving in uniform circular motion in concentric circles of radii r_A and r_B with speed v_A and v_B respectively. Their time period of rotation is the same. The ratio of angular speed of A to that of B will be: *(2019)*

a. $r_A : r_B$ b. $v_A : v_B$

c. $r_B : r_A$ d. 1 : 1

15. When an object is shot from the bottom of a long smooth inclined plane kept at an angle 60° with horizontal, it can travel a distance x_1 along the plane. But when the inclination is decreased to 30° and the same object is shot with the same velocity, it can travel x_2 distance. Then $x_1 : x_2$ will be: *(2019)*

a. $1:\sqrt{2}$ b. $\sqrt{2}:1$

c. $1:\sqrt{3}$ d. $1:2\sqrt{3}$

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	c	d	b	d	d	c	c	c	a	d	a	a	d	c